

**COMMANDER NAVAL AIR FORCES
FOREIGN OBJECT DAMAGE MISHAP ANALYSIS**

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AIRFOR FOREIGN OBJECT DAMAGE MISHAPS

In this study mishaps due to FOD are events where the aircraft sustained damage as a result of impact with an aircraft component, substance or debris. Only class C or more severe events were included. Five years (FY2004-FY2009) were analyzed. CNATRA FOD mishaps were also included in the analysis.

Figure 1 displays the number and rate of FOD mishaps per 100,000 flight hours by aircraft model.

Acft Model	FOD Events	Flt Hrs	Rate	p-value
F-16	3	2,430	123.46	0.000
T-45	14	359,914	3.89	0.012
MH-53	1	26,181	3.82	0.776
F/A-18	32	1,028,719	3.11	0.002
E-6	2	69,994	2.86	0.753
EA-6B	4	151,886	2.63	0.631
P-3/EP-3	9	348,632	2.58	0.401
E-2	2	97,602	2.05	1.000
TH-57	1	249,080	0.40	0.097
H-60	1	655,458	0.15	0.000
B737	1	-	-	-
T-34	0	584,643	0.00	-
T-44	0	126,004	0.00	-
T-39	0	47,881	0.00	-
Grand Total	70			

Fig 1: FOD Mishap Rate

Flight hours for the B737 (flown by VQ-7) were not available. P-values below 0.05 mean the rate is significantly different from the other rates. The three with significantly high rates are small wing jet aircraft. If only the small wing jet aircraft are compared (F-16, T-45, F/A-18, EA-6B, T-39), only the F-16 has a significantly high rate. Additionally, although the H-60 aircraft is significantly low when compared to all other aircraft, it is not significant when compared to just helicopters.

Figure 2 shows the number of mishaps and mishap rate by type commander. CNATRA is significantly lower than CNAL and CNAP. This is a result of zero FOD mishaps for the T-34, T-44 and T-39.

	CNAL	CNAP	CNATRA
FOD Events	25	28	17
Rate	2.22	1.96	1.07
p-value	0.148	0.403	0.019

Fig 2: FOD Mishap Rate By TYCOM

Figure 3 breaks down FOD mishaps by aircraft and TYCOM.

NUMBER OF FOD EVENTS				RATE OF FOD EVENTS			
Acft Model	CNAL	CNAP	CNATRA	Acft Model	CNAL	CNAP	CNATRA
F/A-18	17	13	2	F/A-18	3.75	2.31	16.02
T-45			14	T-45	-	-	3.89
P-3/EP-3	4	5		P-3/EP-3	2.37	2.78	-
EA-6B		4		EA-6B	-	2.63	-
F-16		3		F-16	-	123.46	-
E-2	2			E-2	3.39	0.00	-
E-6		2		E-6	-	2.86	-
TH-57			1	TH-57	-	-	0.40
B737		1		B737	-	-	-
H-60	1			H-60	0.33	0.00	0.00
MH-53	1			MH-53	3.82	-	-

Fig 3: Number/Rate Of FOD Mishaps

Bird strikes accounted for 40 of 70 FOD mishaps (57%). Figures 4 and 5 show the number and rate of bird and non-bird strike FOD mishaps.

Acft Model	Bird Events	Flt Hrs	Rate
F-16	3	2,430	123.46
T-45	9	359,914	2.50
EA-6B	3	151,886	1.98
P-3/EP-3	6	348,632	1.72
F/A-18	16	1,028,719	1.56
E-6	1	69,994	1.43
E-2	1	97,602	1.02
B737	1	-	-

Fig 4: Bird Strike FOD Mishaps

Acft Model	Other FOD	Flt Hrs	Rate
MH-53	1	26,181	3.82
F/A-18	16	1,028,719	1.56
E-6	1	69,994	1.43
T-45	5	359,914	1.39
E-2	1	97,602	1.02
P-3/EP-3	3	348,632	0.86
TH-57	1	249,080	0.40
EA-6B	1	151,886	0.66
H-60	1	655,458	0.15

Fig 5: Non-Bird Strike FOD Mishaps

Figure 6 lists by aircraft the object that caused the FOD and the part of the aircraft that was damaged. Other

than bird strikes, a large number of F/A-18 refueling basket FOD mishaps occurred.

Acft Model	Object	Damage	Total
F/A-18	Bird	Engine	12
		Flir Pod	1
		Multiple	1
		Port Aileron	1
		Vertical Stabilizer	1
	Refueling Basket	Engine	8
	Fastener/Bolt	Engine	2
	Hail	Airframe	1
	Antenna	Engine	1
T-45	Engine Intake	Engine	1
	Ground Refueling Receptacle	Engine	1
	Metal Box	Canopy	1
	Unsecured Object	Flap	1
	Bird	Engine	6
		Canopy	2
		Wing	1
	Canopy Cover	Engine	1
	Cell Phone	Engine	1
P-3	Cranial	Engine	1
	Gear Pin	Engine	1
	Turn Screen Strap	Engine	1
	Bird	Engine	4
		Radome	1
EA-6B	Bird	Vertical Stabilizer	1
		Engine	1
	Clamp	Engine	1
	Coin	Engine	1
	Unknown Object	Engine	1
F-16	Bird	Engine	2
		Multiple	1
B737	Tail Skag	Engine	1
F-16	Bird	Engine	3
	Bird	Slat	1
E-2	Bird	Engine	1
	Tire	Propellor	1
E-6	Bird	Engine	1
	Refueling Boom	Wing	1
TH-57	Hail	Airframe	1
H-60	Plastic Bag	Main Transmission	1
MH-53	Fastener/Bolt	Engine	1
Grand Total			70

Fig 6: FOD Damage By Aircraft Model

Figure 7 displays the phase of operations in which the FOD mishap occurred.

Level 1	Level 2	Level 3	Total
INFLIGHT	NORMAL	NO FURTHER BREAKDOWN	14
		OVERWATER/OVERLAND NAVIGATION	2
		TRANSIENT; LOW ALTITUDE	5
	OTHER MANEUVERS	REFUELING	8
		LOW LEVEL NAVIGATION/TERRAIN FLIGHT	1
	LANDING PATTERN	NO FURTHER BREAKDOWN	4
	CLIMB OUT	NO FURTHER BREAKDOWN	3
		TOUCH AND GO LANDING	1
OFFENSIVE MANEUVERS	COMBAT TACTICS	1	
	DEFENSIVE WEAVE	1	
VFR BREAK	NO FURTHER BREAKDOWN	2	
UNDETERMINED	NO FURTHER BREAKDOWN	2	
NOT INCIDENT TO FLIGHT	PARKED AIRCRAFT	NO FURTHER BREAKDOWN	1
		FIELD PARKING LINE	2
	POST FLIGHT INSPECTION	NO FURTHER BREAKDOWN	1
		FIELD PARKING LINE	1
	STARTING ENGINES	TURN UP AREA	2
	NO FURTHER BREAKDOWN	NO FURTHER BREAKDOWN	1
	PARKED AIRCRAFT DURING MAINTENANCE	NO FURTHER BREAKDOWN	1
	PREFLIGHT INSPECTION	NO FURTHER BREAKDOWN	1
TURNAROUND INSPECTION	FIELD PARKING LINE	1	
ENGINES RUNNING	TURN UP AREA	1	
TAKEOFF	AIRCRAFT BREAKS GROUND	NO FURTHER BREAKDOWN	4
		ACTUAL OR SIMULATED INSTRUMENT TAKEOFF	1
	ROLL OUT; TOUCHDOWN TO TAXI	NO FURTHER BREAKDOWN	2
LANDING	LEVEL OFF/TOUCHDOWN	NO FURTHER BREAKDOWN	1
		INFLIGHT ENGAGEMENT OF ARRESTING WIRE	1
	NO FURTHER BREAKDOWN	NO FURTHER BREAKDOWN	1
	ROLL OUT; TOUCHDOWN TO TAXI	NO FURTHER BREAKDOWN	1
INTENT FOR FLIGHT	NO FURTHER BREAKDOWN	NO FURTHER BREAKDOWN	2
DESCENT	GCA/PAR	NO FURTHER BREAKDOWN	1
Grand Total			70

Fig 7: FOD Mishap Phase Of Operations

Figures 8 and 9 break down phase of operations by bird strike mishaps and non-bird strike mishaps.

Level 1	Level 2	Level 3	Total
INFLIGHT	NORMAL	NO FURTHER BREAKDOWN	10
		OVERWATER/OVERLAND NAVIGATION	2
		TRANSIENT; LOW ALTITUDE	5
	LANDING PATTERN	NO FURTHER BREAKDOWN	4
	CLIMB OUT	NO FURTHER BREAKDOWN	3
	VFR BREAK	TOUCH AND GO LANDING	1
	UNDETERMINED	NO FURTHER BREAKDOWN	2
	OFFENSIVE MANEUVERS	DEFENSIVE WEAVE	1
TAKEOFF	OTHER MANEUVERS	LOW LEVEL NAVIGATION/TERRAIN FLIGHT	1
	AIRCRAFT BREAKS GROUND	NO FURTHER BREAKDOWN	4
NOT INCIDENT TO FLIGHT	POST FLIGHT INSPECTION	ACTUAL OR SIMULATED INSTRUMENT TAKEOFF	1
LANDING	LEVEL OFF/TOUCHDOWN	NO FURTHER BREAKDOWN	1
	NO FURTHER BREAKDOWN	NO FURTHER BREAKDOWN	1
DESCENT	GCA/PAR	NO FURTHER BREAKDOWN	1
Grand Total			40

Fig 8: FOD Bird Strike Mishap Phase Of Operations

Level 1	Level 2	Level 3	Total
INFLIGHT	OTHER MANEUVERS	REFUELING	8
	NORMAL	NO FURTHER BREAKDOWN	4
	OFFENSIVE MANEUVERS	COMBAT TACTICS	1
NOT INCIDENT TO FLIGHT	PARKED AIRCRAFT	FIELD PARKING LINE	2
		NO FURTHER BREAKDOWN	1
	STARTING ENGINES	TURN UP AREA	2
	TURNAROUND INSPECTION	FIELD PARKING LINE	1
	PREFLIGHT INSPECTION	NO FURTHER BREAKDOWN	1
	POST FLIGHT INSPECTION	FIELD PARKING LINE	1
	PARKED AIRCRAFT DURING MAINTENANCE	NO FURTHER BREAKDOWN	1
	NO FURTHER BREAKDOWN	NO FURTHER BREAKDOWN	1
LANDING	ENGINES RUNNING	TURN UP AREA	1
	ROLL OUT; TOUCHDOWN TO TAXI	NO FURTHER BREAKDOWN	1
	LEVEL OFF/TOUCHDOWN	INFLIGHT ENGAGEMENT OF ARRESTING WIRE	1
INTENT FOR FLIGHT	NO FURTHER BREAKDOWN	NO FURTHER BREAKDOWN	2
TAKEOFF	ROLL OUT; TOUCHDOWN TO TAXI	NO FURTHER BREAKDOWN	2
Grand Total			30

Fig 9: FOD Non-Bird Strike Mishap Phase Of Operations

Figures 10 and 11 detail the location of the FOD mishaps. One chart lists all FOD mishaps, the other only bird strikes.

ALL FOD EVENTS		
Acft Model	Location	Total
F/A-18	LEMOORE NAS	8
	EMBARKED	6
	OCEANA NAS	5
	FENTRESS NALF	2
	FALLON	2
	SCOTT AFB MIDAMERICA	1
	SAVANNAH INTL	1
	KEY WEST	1
	EL CENTRO	1
	DARE COUNTY TARGET	1
	CHINA LAKE	1
	BURKE LAKEFRONT	1
	BEAUFORT MCAS	1
	ATSUGI NAF	1
T-45	KINGSVILLE NAS	5
	MERIDIAN NAS	4
	EMBARKED	1
	MISSISSIPPI	1
	MCCAIN	1
	JOE WILLIAMS NOLF	1
	ALABAMA	1
P-3	KANEOHE BAY MCAF	2
	EL SALVADOR INTL	2
	SIGONELLA	1
	MC CHORD AFB	1
	CECIL FLD	1
	BRUNSWICK NAS	1
	AL UDEID	1
EA-6B	WHIDBEY ISLAND	2
	FALLON	1
	BAGRAM	1
F-16	FALLON	3
TH-57	WHITING FIELD	1
E-2	EMBARKED	1
	ELIZABETH CITY CGAS RGNL	1
E-6	TINKER AFB	1
	GLACIER PARK INTL	1
H-60	MAYPORT NS	1
MH-53	CORPUS CHRISTI NAS	1
B737	ROSWELL INDUSTRIAL AIR CENTER	1
Grand Total		70

Fig 10: FOD Mishap Location

BIRD STRIKES		
Acft Model	Location	Total
F/A-18	OCEANA NAS	4
	LEMOORE NAS	3
	FENTRESS NALF	2
	EMBARKED	1
	FALLON	1
	SAVANNAH INTL	1
	KEY WEST	1
	EL CENTRO	1
	BURKE LAKEFRONT	1
	BEAUFORT MCAS	1
T-45	KINGSVILLE NAS	3
	MERIDIAN NAS	3
	MISSISSIPPI	1
	JOE WILLIAMS NOLF	1
	ALABAMA	1
P-3	EL SALVADOR INTL	2
	KANEOHE BAY MCAF	1
	SIGONELLA	1
	MC CHORD AFB	1
	CECIL FLD	1
EA-6B	FALLON	1
	WHIDBEY ISLAND	1
	BAGRAM	1
F-16	FALLON	3
E-2	ELIZABETH CITY CGAS RGNL	1
E-6	GLACIER PARK INTL	1
B737	ROSWELL INDUSTRIAL AIR CENTER	1
Grand Total		40

Fig 11: Bird Strike FOD Mishap Location